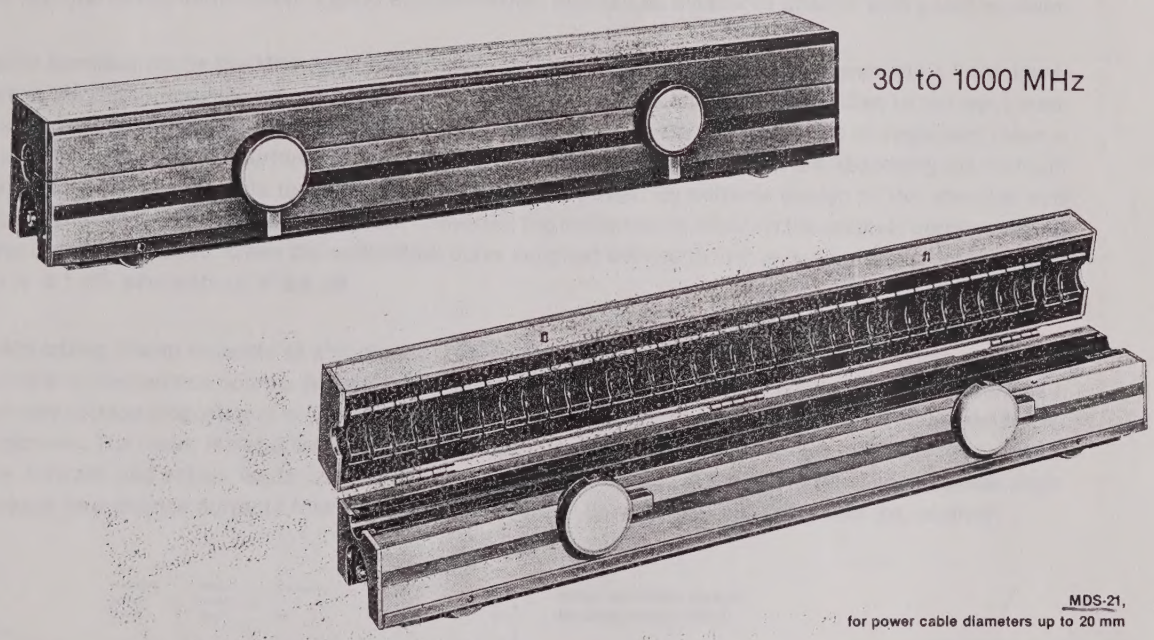
Electronic Services - Hayward, Ca
M20566X

ROHDE&SCHWARZ

MDS-21

ABSORBING CLAMP

30 to 1000 MHz



MDS-21,
for power cable diameters up to 20 mm

Absorbing Clamp *) for direct measurement of RF interference power (using a test receiver) introduced by the interference source, e.g. household appliance or electric tool, on the power cable.

Measuring Radio Interference

For perfect reception of radio and television signals, interference from electrical appliances etc. must be kept within certain limits. The amount of interference from an interference source is expressed as either a voltage, power, current or field strength. Below 30 MHz the interference is defined in many regulations in terms of the interference voltage produced by the appliance across the terminals of an artificial AC-supply network. This is because the interference is mainly propagated via the power cable. In the VHF region, however, where the interference is radiated directly, the definition is usually in terms of field strength at a certain distance. Since this measurement is relatively involved, several regulations tolerate the use of the MDS absorbing clamp as an alternative to field-strength measurements, some even make it compulsory.

Characteristics and Uses

The Absorbing Clamp MDS-21 in conjunction with an interference measuring receiver according to CISPR Publication 16, permits interference to be measured directly as the noise power introduced by the interference source on the power cable. The MDS-21 is easy and reliable to operate, and the results are reproducible.

*) According to CISPR Publication 16 - Specification for CISPR Radio Interference Measuring Apparatus and Measurement Methods - Paragraph 4.1.3 (and VDE 0876).

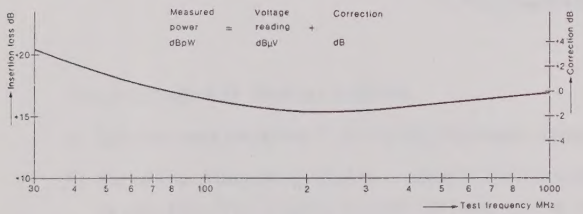
Mode of Operation and Construction

Interference is mainly radiated from the power cable of the interference source (e.g. household appliance) and is by agreement defined as the power that would have to be radiated by an antenna (replacing the power cable) to produce the same amount of interference.

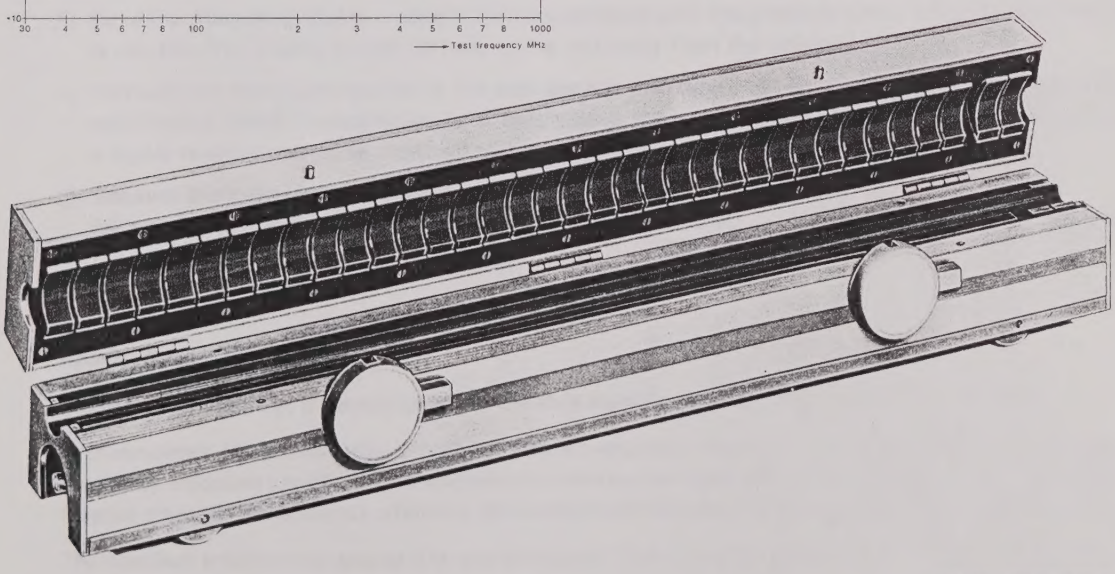
If an absorber is placed over the frequency-dependent interference maximum, the absorbed power coincides with the above definition to a good approximation, and can be measured directly with a test receiver.

A ferrite absorber inside the MDS Absorbing Clamp encircles the power cable and represents a lossy impedance to the high-frequency interference power. A test receiver (e.g. type ESV) connected to the input measures the RF current flowing in the absorber via a current converter. Because with this arrangement there is no matching between the interference source, the power cable and the absorber, the Absorbing Clamp must be slid along the power cable to the position of maximum power. By suitable design of the absorber and choice of the conversion ratio of the current converter, the indication in dBµV on the receiver corresponds to a measurement in dBpW. When the calibration curve supplied with each unit is used, the error of measurement is ±1 dB, and without it ±4 dB.

The Absorbing Clamp consists of a number of ferrite rings arranged side by side and encircling the power cable of the interference source. Several of these rings are part of the current converter which produces a secondary voltage proportional to the RF current flowing in the power cable. This voltage is measured by the test receiver. The result is not affected by the AC supply current flowing in the cable, because the currents in the forward and return leads compensate each other. A coaxial filter is included to suppress high-frequency interference currents flowing in the cable screen between the converter and the receiver.



Typical calibration curve of Absorbing Clamp MDS-21

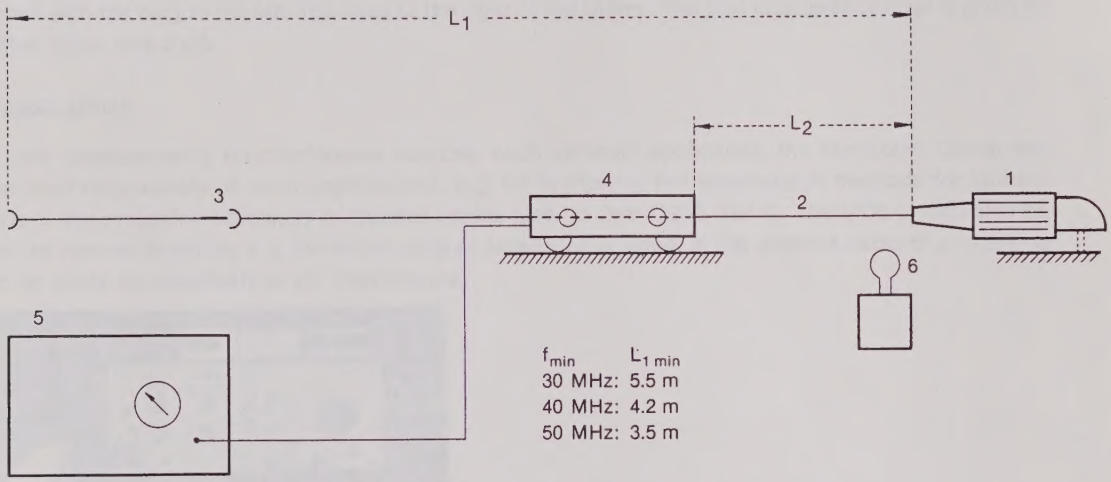


Absorbing Clamp MDS-21

The plastic case of the unit consists of two hinged parts each containing a set of ferrite ring halves. The latter are held in sprung plastic holders to form a channel for the power cable of the interfering appliance. By closing the two halves of the unit the magnetic circuit around the cable is completed. Eccentric catches provide the required contact pressure. Rollers are provided to facilitate moving the Clamp when searching for interference maxima.

Test Procedure

To measure the interference from an appliance 1, the latter is placed on a non-conducting surface (test table) so that it is at least 40 cm from a conducting floor or wall. Depending on the lowest interference frequency to be measured, the length of the power cable must be increased to the minimum L_1. The cable is then stretched out horizontally and placed into the Absorbing Clamp such that the latter - when closed - can be easily moved along the cable. The converter end (green mark) of the Absorbing Clamp should face the appliance under test.



Interference measurement setup

1 Interference source
2 Extended power cable
3 Power plug (line connector)
4 Absorbing Clamp
5 Test receiver
6 Auxiliary interference source

The procedure is then as follows:

a) Set the test receiver 5 to the appropriate frequency (e.g. lowest) and switch on the appliance.

b) Move the Absorbing Clamp 4 away from the appliance until the greatest meter deflection on the receiver is reached. The Clamp should be held at the end away from the appliance.

c) Normally the maximum nearest to the appliance is measured, but with frequencies above 150 MHz this can often lie within the appliance itself. In this case, move the Clamp to the 2nd maximum (distance L_2) if a higher reading cannot be obtained with the Clamp as close to the appliance as possible.

d) Measure the interference intensity on the receiver's meter,
With calibration in dBµV:

$$\frac{\text{Interference}}{\text{dBpW}} = \frac{\text{Indication}}{\text{dB}\mu\text{V}} + \frac{\text{Correction value acc. to cal. curve}}{\text{dB}}$$

Special Cases

Measuring unstable or discontinuous interference signals (see CISPR, Publ. 16, Amendment 2)

In these cases, the power cable is fed with a continuous and constant interference signal from an auxiliary source by inductive coupling. This enables the interference maximum to be determined. A convenient interference source is, for instance, a battery-operated electric shaver with the suppression components removed.

The auxiliary interference source 6 is placed approx. 15 cm from the power cable and 10 cm from the interfering appliance; the power plug of the appliance should be withdrawn.

After the test receiver has been tuned to the appropriate frequency, the auxiliary interference source is switched on and the Clamp moved along the cable to the point where maximum is obtained (at L_2). The auxiliary source is now switched off, the appliance under test switched on, and the interference measured as described above.

ABSORBING CLAMP MDS-21

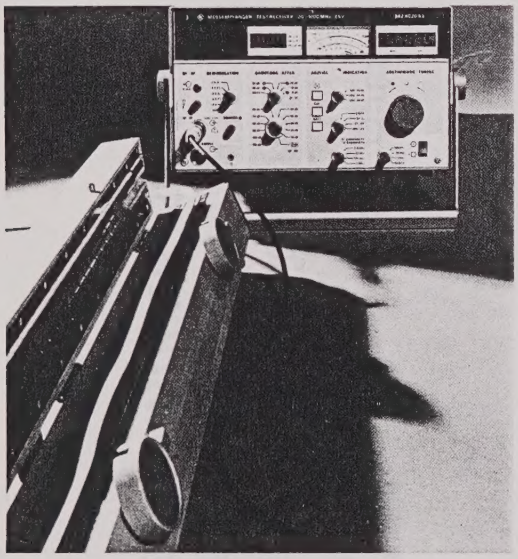
Approximate measurements where space is confined

Place the power cable of the interfering appliance in the Absorbing Clamp and gather the length of cable (on both sides of the Clamp), which cannot be laid out, into bunches, taking care not to form a coil. Depending on the frequency, this method yields results 0 to 3 dB too high.

If a power plug or line connector prevents the maximum from being found, two measurements are necessary, once with the plug to the left and once to the right of the Clamp. The true interference level is given by the higher value plus 2 dB.

Other applications

Apart from measurements on interference sources, such as small appliances, the Absorbing Clamp can also be used for a variety of other applications, e.g. for evaluating RFI suppression methods for ignition systems or the screening efficiency of coaxial cables (acc. to DIN 47250, Teil 6). The MDS-21 can also be used in the reverse direction, e.g. for introducing an interference signal in the antenna cable of a receiving system to check its sensitivity to RF interference.



Interference measurement using
Test Receiver ESV
and Absorbing Clamp MDS-21

Specifications

Calibrated for receiver impedance	50 Ω
Max. current (f < 500 Hz)	30 A
Max. input power when used as coupling unit for immunity tests	5 W
Diameter of appliance power cable	up to 20 mm
Overall dimensions (W x H x D)	610 mm x 115 mm x 80 mm
Weight	6.3 kg
Order designation	▶ Absorbing clamp MDS-21*) 194.0100.50

Accessories supplied

1 coaxial cable (connects MDS-21 to test receiver) 5 m long with two male BNC connectors
1 calibration curve (takes cable attenuation into account)

Recommended extras

Adapter (BNC female to N male for ESV, ESVP)	118.2812.00

*) after Meyer de Stadelhofen (Switzerland)

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ABSORPTIONS-MESSWANDLER-ZANGE
ABSORBING CLAMP

MDS 21

● SYSTEM MEYER DE STADELHOFEN/LÜTHI

Empfänger-Eingangswiderstand
Receiver Impedance

50 Ohm

F.Nr. 922297
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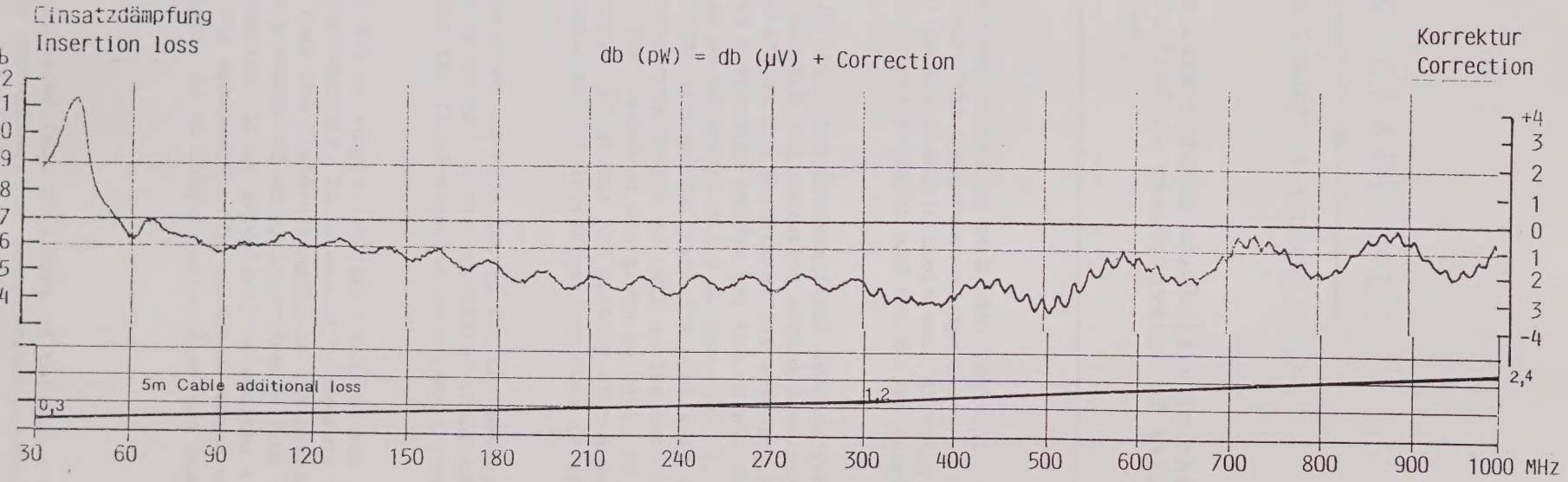

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A B S O R B I N G C L A M P M D S

System Meyer de Stadelhofen/Lüthi

The measuring device for the interference capability in the metric wave-band (30 ... 300, 1000 MC respectively) of mains-operated electrical appliances

In connection with a measuring receiver according to CISPR, Publ.16, the absorbing clamp MDS enables to measure the interference capability of radio interferers, such as domestic appliances, electric tools etc. directly; viz. by measuring the power generated by the interferer and fed to its supply cable.

At the plenary meeting in Stresa in 1967, the International Special Committee on Radio Interference (CISPR) adopted the measuring method developed by Mr. Meyer de Stadelhofen and his staff in the department for research and development of the Swiss PTT (1) as a standard method for the metric wave-band. It has decided to insert same as paragraph 4.1.3 in its Publ. 2. The relevant text makes part of Doc. CISPR (Bureau Central) 338 published in January 1968, describing the new measuring device as well as the method of calibrating it. Exact instructions for procedure are given as well. In addition to that, Doc. CISPR (Secretariat) 727 states the history of the development of this new device and also mentions the investigations made in various countries.

The measurement of the interference power is substituted for the measurement of the interference voltage at the terminals of the interferer connected to an artificial mains network, and for the field-strength measurement respectively.

Measuring with the absorbing clamp MDS is simple, reliable and, if the interference source is constant, well reproducible. It is easier to measure the power generated by the interferer than the field-strength. As the absorbing clamp MDS is not influenced by the presence of stray interference from other sources, no screening cabin is necessary. It is especially noteworthy that a changement of the surroundings of the appliance to be measured, which was essential for the previous procedures, is no longer influencing the test results.

Principle

The interference energy is mainly radiated from that part of the mains cable which is next to the interferer. By convention, the interference capability is defined in terms of the power which would be radiated by a tuned aerial

that fed to an absorbing device joined to the mains cable and distanced from the interference source so that it absorbes the maximum power at the specific frequency the receiver is set at.

When a generator with a source impedance of 50 ohms supplies a suitable load, its terminal voltage expressed in dB (µV) has the same numerical value as the power input in dB (pW) increased by the constant 17. If the measuring device between interference source and receiver effects a damping of 17 dB over the whole measuring range the power generated by the interferer can be read in dB (pW) directly on the measuring receiver calibrated in dB (µV).

The absorbing clamp MDS is based on these considerations and enables to measure the interference power in the frequency range from 30 to 300 (1000 respectively) MC directly. The exactitude is within ± 3 dB, which is sufficient in most cases. Whenever an especially exact measuring is necessary, a correction can be taken out of the calibration curve supplied together with the device.

The absorbing clamp is calibrated in accordance with the substitution method.

Construction

The device consists of a great number of ferrite rings surrounding the interferer's mains cable. These rings are arranged in a straight row, and some of them are components of the coupling transformer. The output voltage is proportional to the high-frequent current in the cable. The voltage is measured by an interference measuring receiver. The result is uninfluenced by the operating current in the mains cable as the currents, being in opposite directions, compensate. A coaxial filter stops the high-frequent interference currents which could circulate via the screen of the cable between the absorbing clamp and the receiver.

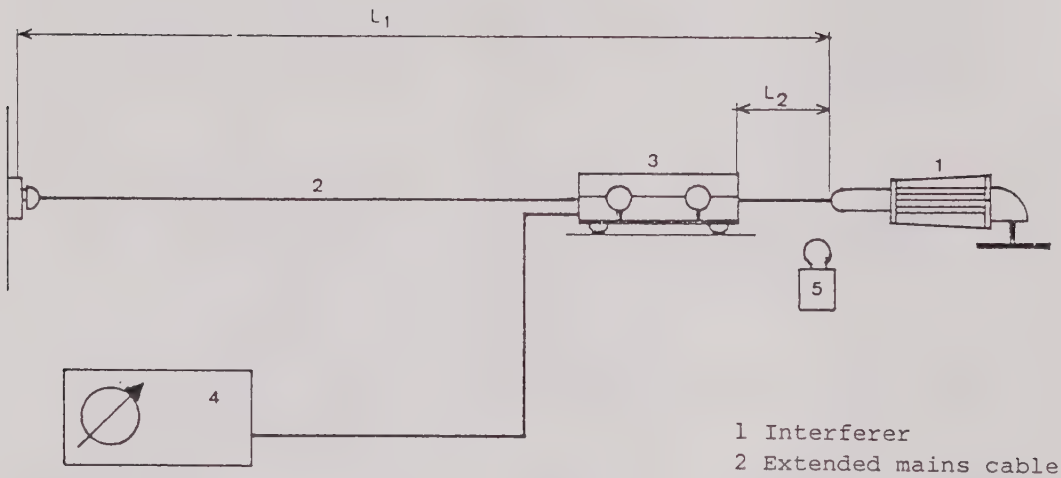
The ferrite rings are split into half-rings, one half being fitted into the lower part of the body of the device and thus forming a channel in which the mains cable of the appliance can be laid. The other half of the rings are arranged in the hinged top part of the clamp. Each half-ring is set in a resilient plastic-holder moving in guide slots. As soon as the clamp is locked with the handy eccentric closures providing the necessary pressure, the magnetic circuits around the cable are closed. The clamp is equipped with four rollers which guarantee a slight shifting for regulating to the maximum.

Other possibilities of application

The absorbing clamp MDS can also be used for investigating the effectiveness of the screening on coaxial cables (2).

Moreover, it can be used in the reverse direction to inject a jamming signal into the screening of a receiving aerial cable in order to measure its immunity to external fields.

INSTRUCTIONS FOR USE



1 Interferer
2 Extended mains cable
3 Absorbing clamp MDS
4 Measuring receiver according to CISPR
5 Auxiliary source of interference

f_{min}	$L_1 min$
30 MC	5.5 m
40 MC	4.2 m
50 MC	3.5 m

1. The bipartite bushing fastened to the absorbing clamp has to be removed for measuring interferers with a mains cable whose diameter exceeds 10 mm. This bushing increases the exactitude when measuring interferers with thin cables.

2. The interferer 1 is placed on an insulating base (measuring bench). The mains cable 2 has to be extended to the length of at least L_1 according to the lowest interference frequency to be measured and must be laid in a straight line. It must be located at a distance of at least 0.7 m from any conducting wall or above conducting floors. After having laid the cable into the channel of the absorbing clamp 3, the latter is locked with the two eccentric closures. Turn the transformer side (green mark, bushing) towards the interferer.

3. Set the measuring receiver 4 at the relevant frequency (for example the lowest) and set the interferer in operation.

4. Move the absorbing clamp away from the interferer until the greatest deflection is obtained on the indicator of the receiver.

   The person who is moving the clamp will grip same at the side turned away from the interferer. In case of a permanent installation it is recommendable to move the clamp on wooden guide rails by the help of a string.

ought to be measured. At frequencies exceeding about 150 MC, however, the maximum often occurs in the handle of the interferer. In this case the distance L_2 is adjusted to the second maximum, provided that this results in a higher value than the measurement with the absorbing clamp pushed close to the interferer.

6. Read the interference capability on the instrument of the receiver.

6.1 If the receiver is calibrated in dB (μV):

Interference capability	=	reading +	correction according to calibration curve
dB (pW)		dB (μV)	dB

6.2 If it is calibrated in μV:

Interference capability	=	20 $\log_{10} \cdot U$ +	correction according to calibration curve
dB (pW)		μV	dB

Kindly note: When not in use the eccentric closures should not be locked.

7. Practical directions

7.1 Measurement of an interferer whose interference voltage is unstable or discontinuous.

In this case the mains cable of the interferer must be inductively coupled with an auxiliary interference source of a continuous and constant interference voltage. A battery-operated shaver 5, for example, is suitable for this purpose.

The auxiliary source of interference is installed at a distance of about 15 cm from the mains cable and about 10 cm from the interferer.

After having adjusted the receiver to the frequency to be measured, the distance L_2 of the absorbing clamp is set for the maximum interference. For this purpose the mains plug of the interferer has to be removed from the mains socket.

Switch off the auxiliary source and set the interferer in operation. Carry out the measurement of interference in accordance with Point 6.

7.2 For measurements to serve as a general guide where space is limited the interferer's mains cable is pulled through the stationary clamp, and the lengths of the cable on both sides which cannot be straightened are put together to form tangled heaps (this means to say that no coil must be formed). Using this method the measuring result is between 0 and 3 dB too high depending on the frequency.

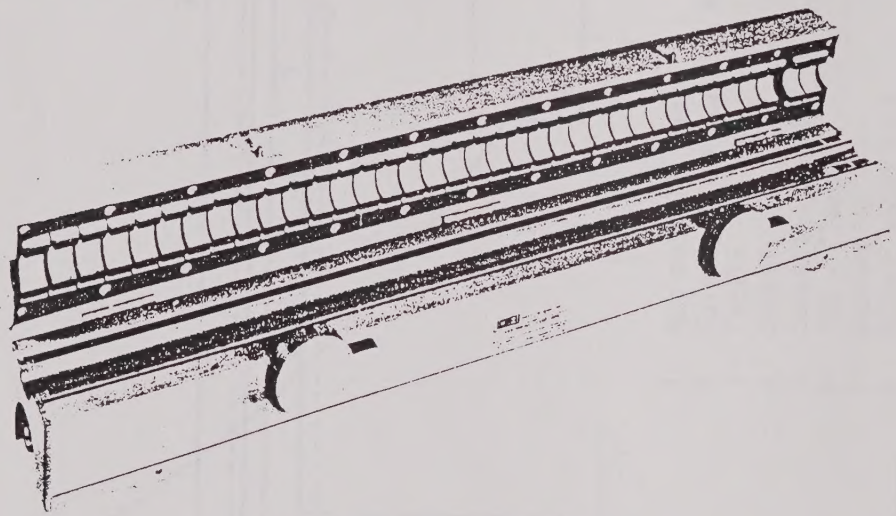
If a mains plug connection or a coupling prevents the determination of the maximum two measurements are carried out: once with the plug close to the right, then to the left side of the clamp. The interference capability corresponds to the higher reading increased by 2 dB.

(1) Technical Information PTT 3-1969

J. Meyer de Stadelhofen/Bersier: The absorbing clamp - a new method of measurement for the interference in the metric wave-band. (Original in French)

(2) Technical Information PTT 5-1971

R. Bersier: Measurement of the electrical immunity of coaxial cables in the metric wave-band by means of the absorbing clamp MDS. (Original in French)



Type MDS 21

Device in the form of a clamp. It is suitable for interference measuring services and laboratries which have to measure the interference capability of numerous various appliances. The hinged top part of the clamp can be opened and the mains cable of the interferer be laid in the channel formed by the split half-rings. After locking the device the magnetic circuits are closed, and the arrangement is ready for measuring. For regulating to the maximum the clamp is equipped with four rollers for a slight shifting.

Frequency range	from (30)...47 up to 1000 MC
Passage for cables	up to 18 mm diameter
Outside dimensions	approx. 80 x 100 x 618 mm
Net weight	6.6 kg

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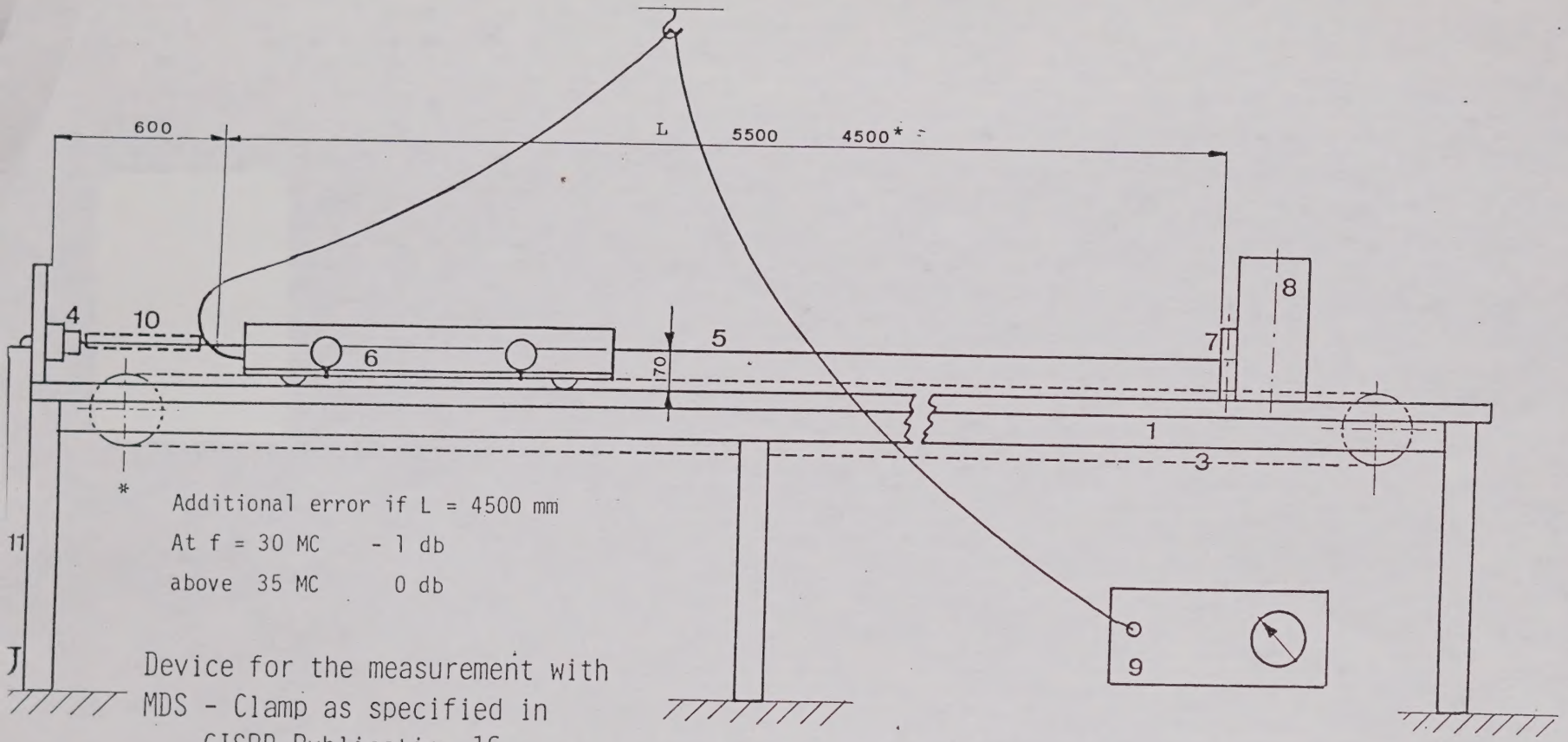
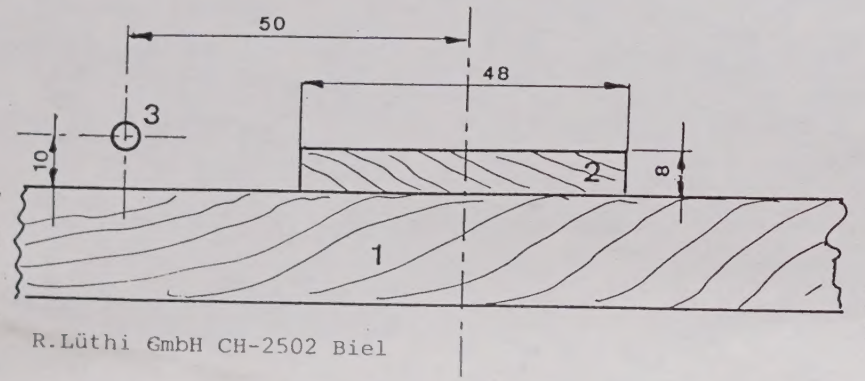
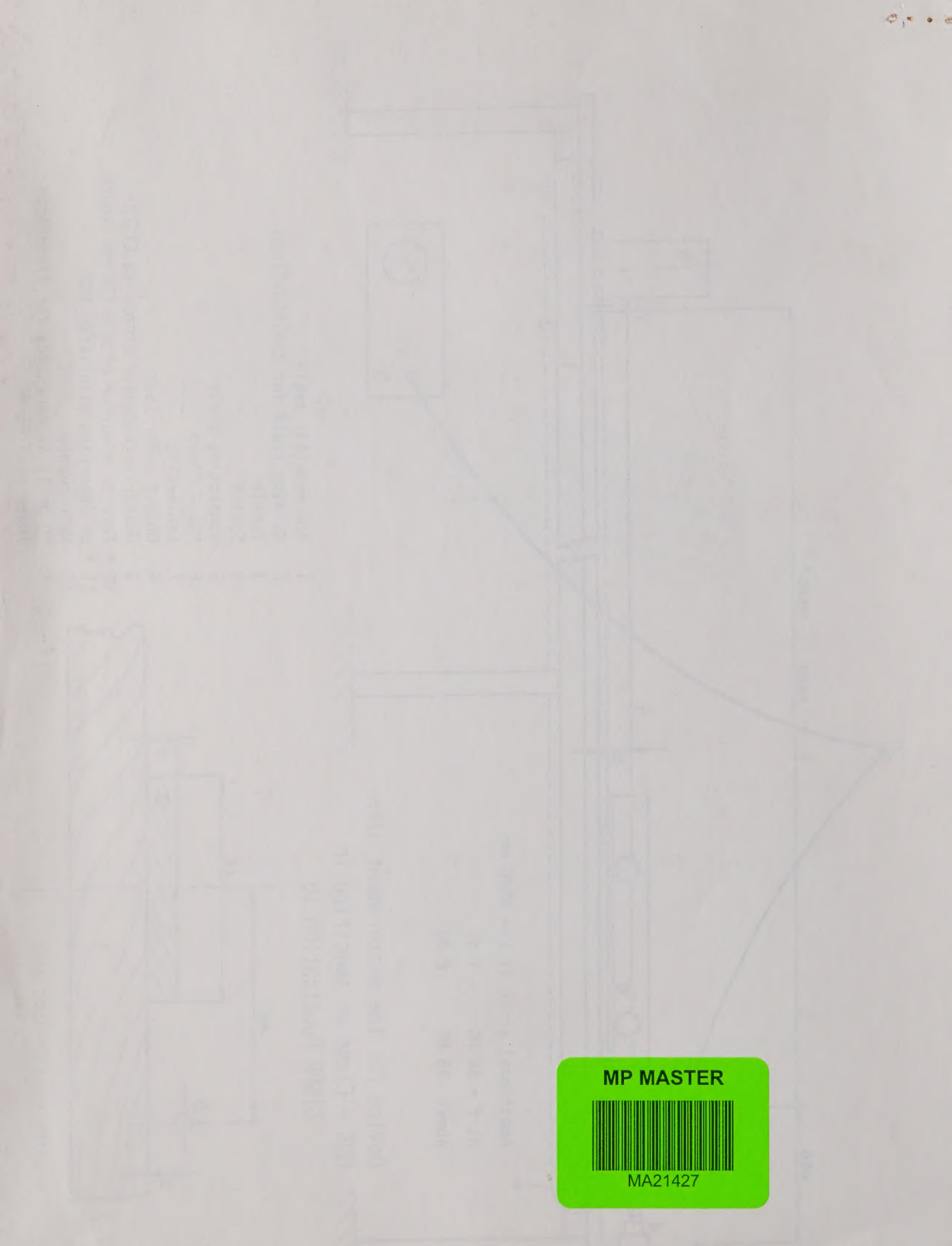


Device for the measurement with MDS - Clamp as specified in CISPR Publication 16



R.Lüthi GmbH CH-2502 Biel

1		Non-metallic table
2		Guiding track for the MDS-Clamp
3		Tackle
4		Socket
5		Connecting cable
6		MDS - Clamp
7		Cable-clip
8		Object under test
9		Measuring receiver according CISPR
10	*	Ferrite absorber of min 500 mm length
11	*	or Absorbing Mainfilter KNF
12		Main supply
*		10 or 11 is necessary for frequencis lower than 45 MC



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